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(54) **DUAL ACTION AIR PUMP**

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(52) **U.S. Cl.** **417/527**
(58) **Field of Search** 417/527, 526, 417/440, 467, 511, 512

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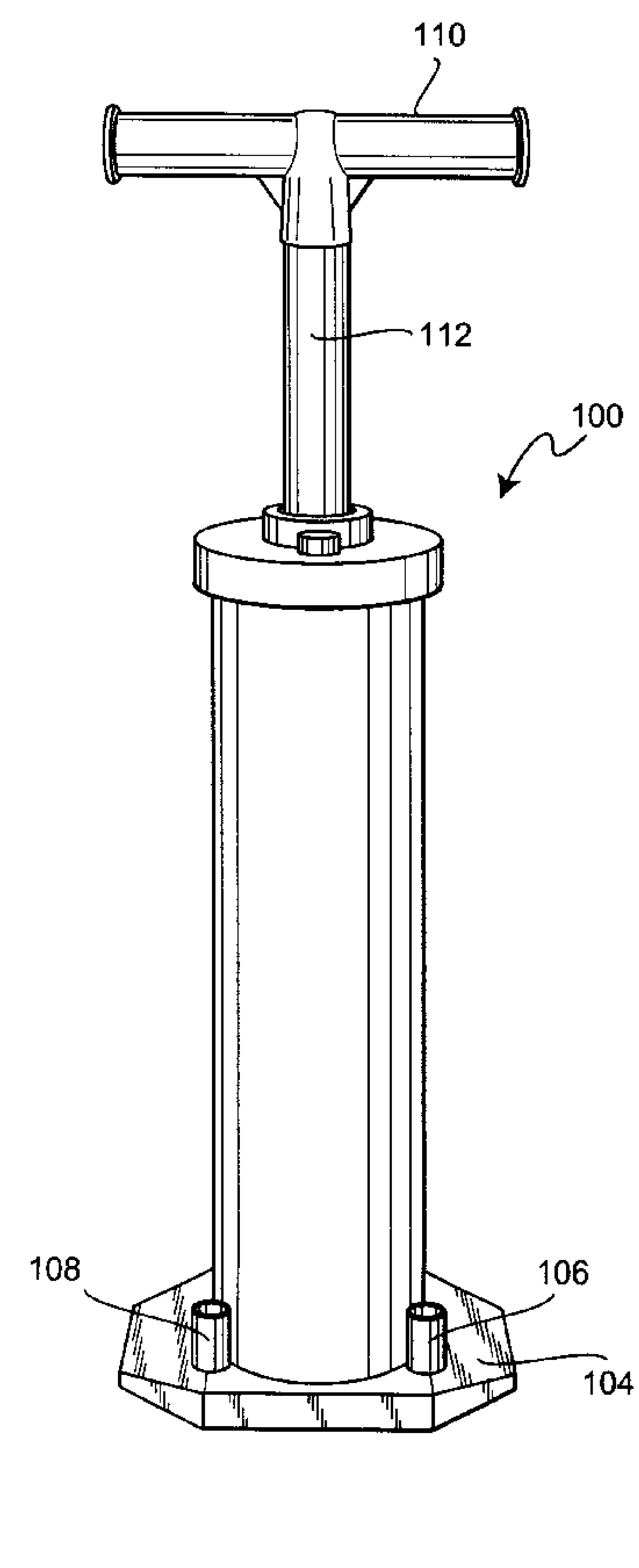
(57) **ABSTRACT**

An air pump is a dual action manually driven with a piston and two intake and two exhaust check values that respectively operate with one intake port and one exhaust port. These check valves operate in tandem with each other during each pumping stroke, either up or down. During each pumping stroke, one intake check valve and one exhaust check valve are open with their counterparts closed, to provide continuous discharge of compressed air through the exhaust port and also to provide continuous intake of air through the intake port. The air pump includes a cylindrically shaped hollow reservoir housing, a base connected to one end of the housing, an intake port and an exhaust or inflate port which are mounted on the base, an elongated piston shaft extending along the longitudinal axis of the housing, and a handle perpendicularly disposed with respect to the piston shaft to assist pumping of the piston shaft.

24 Claims, 5 Drawing Sheets



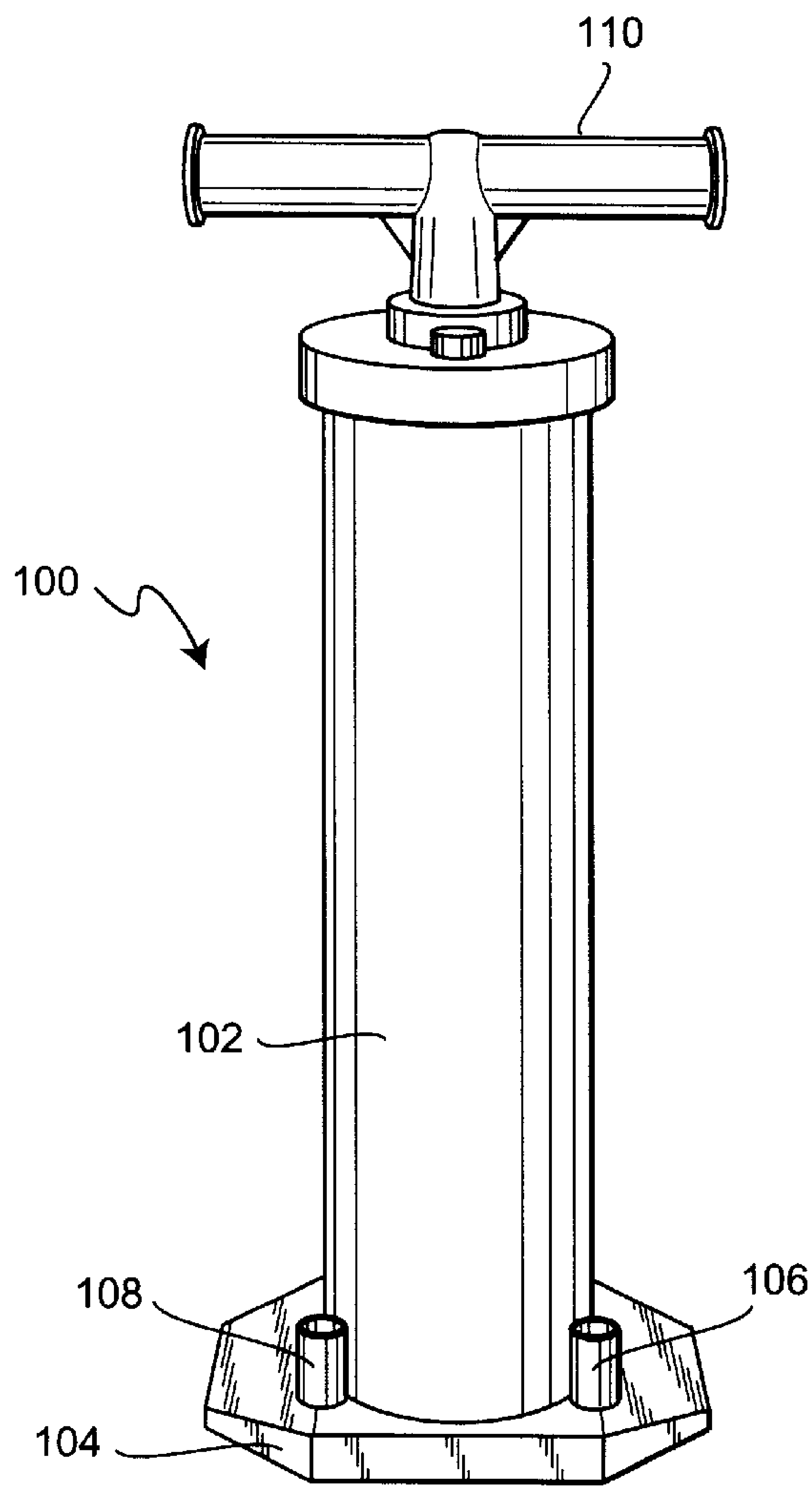


FIG. 1

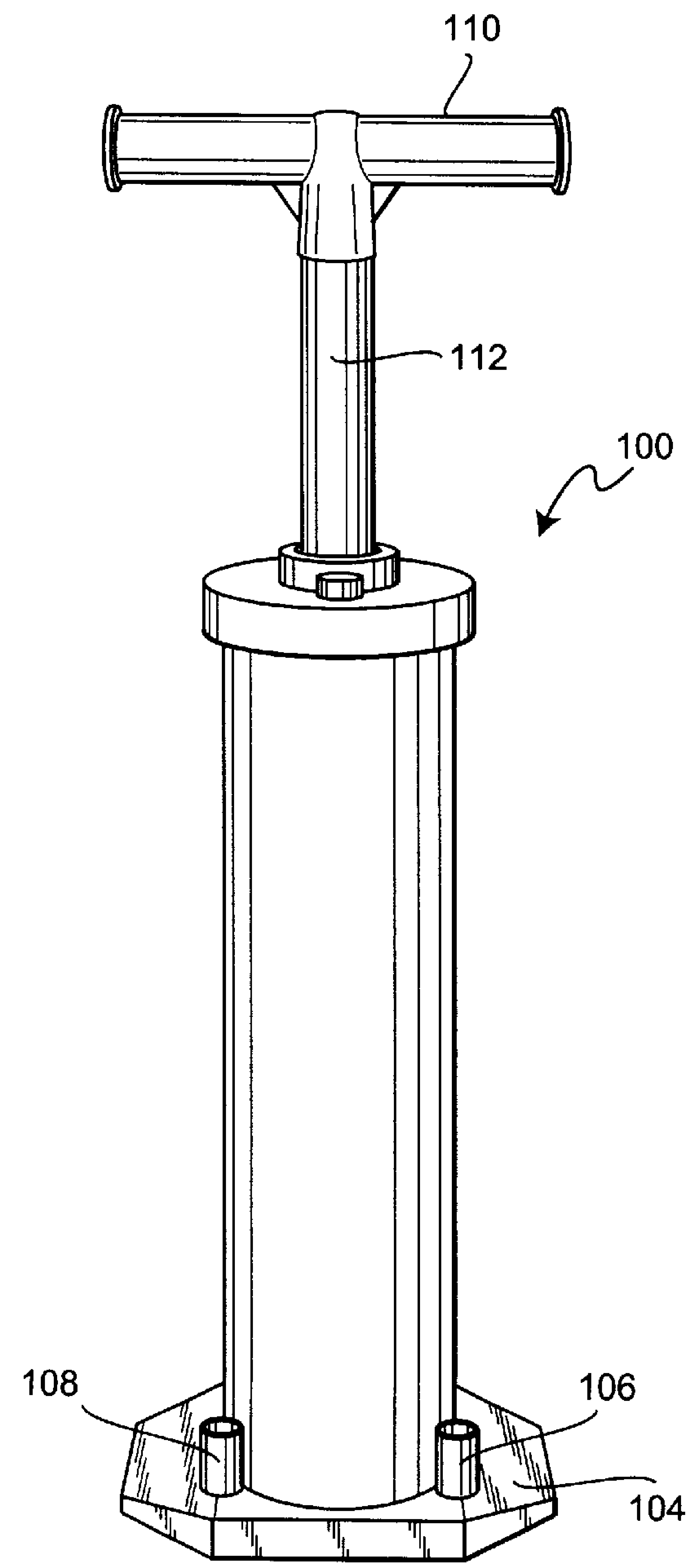


FIG. 2

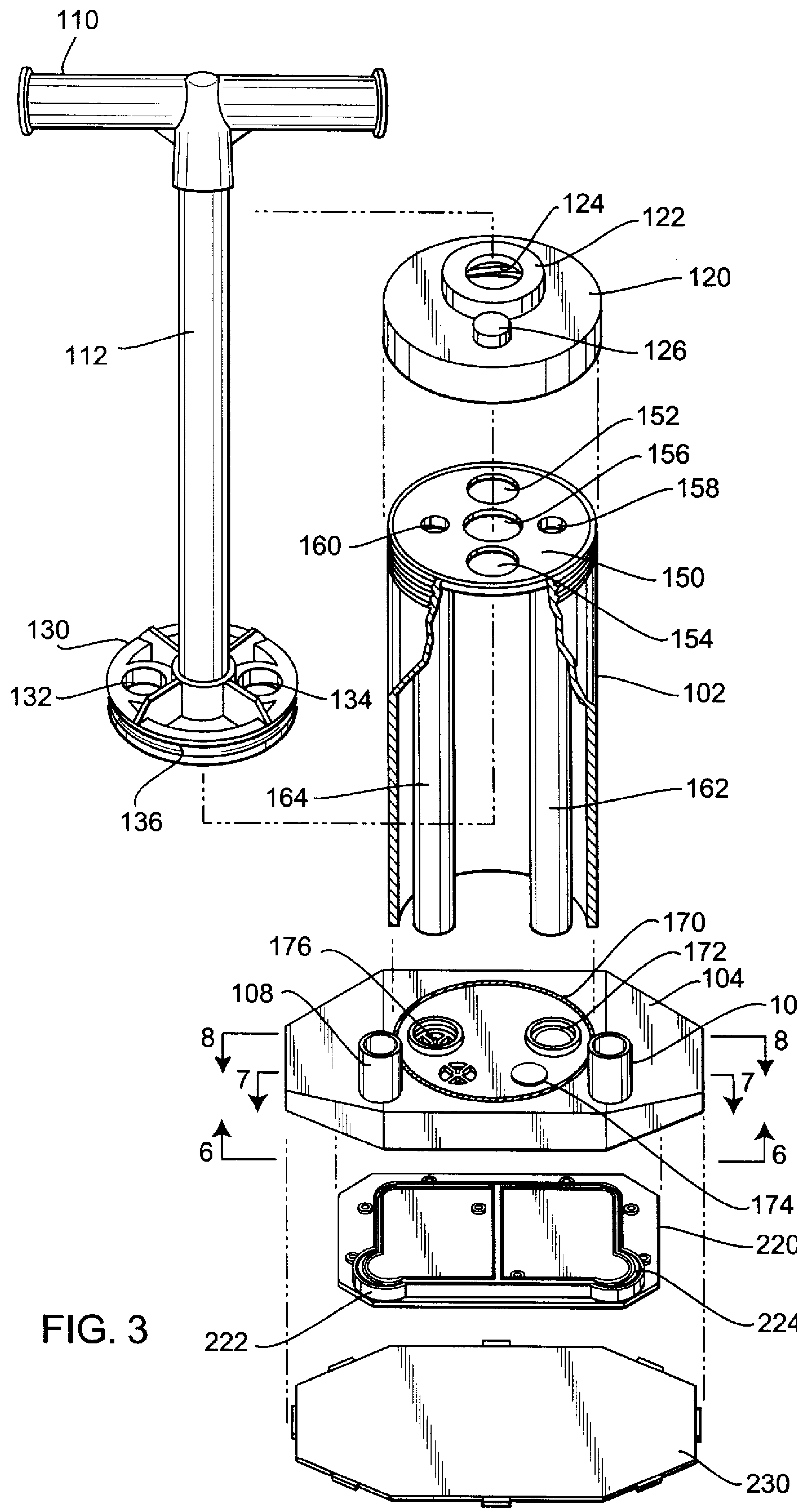

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FIG. 3

FIG. 4

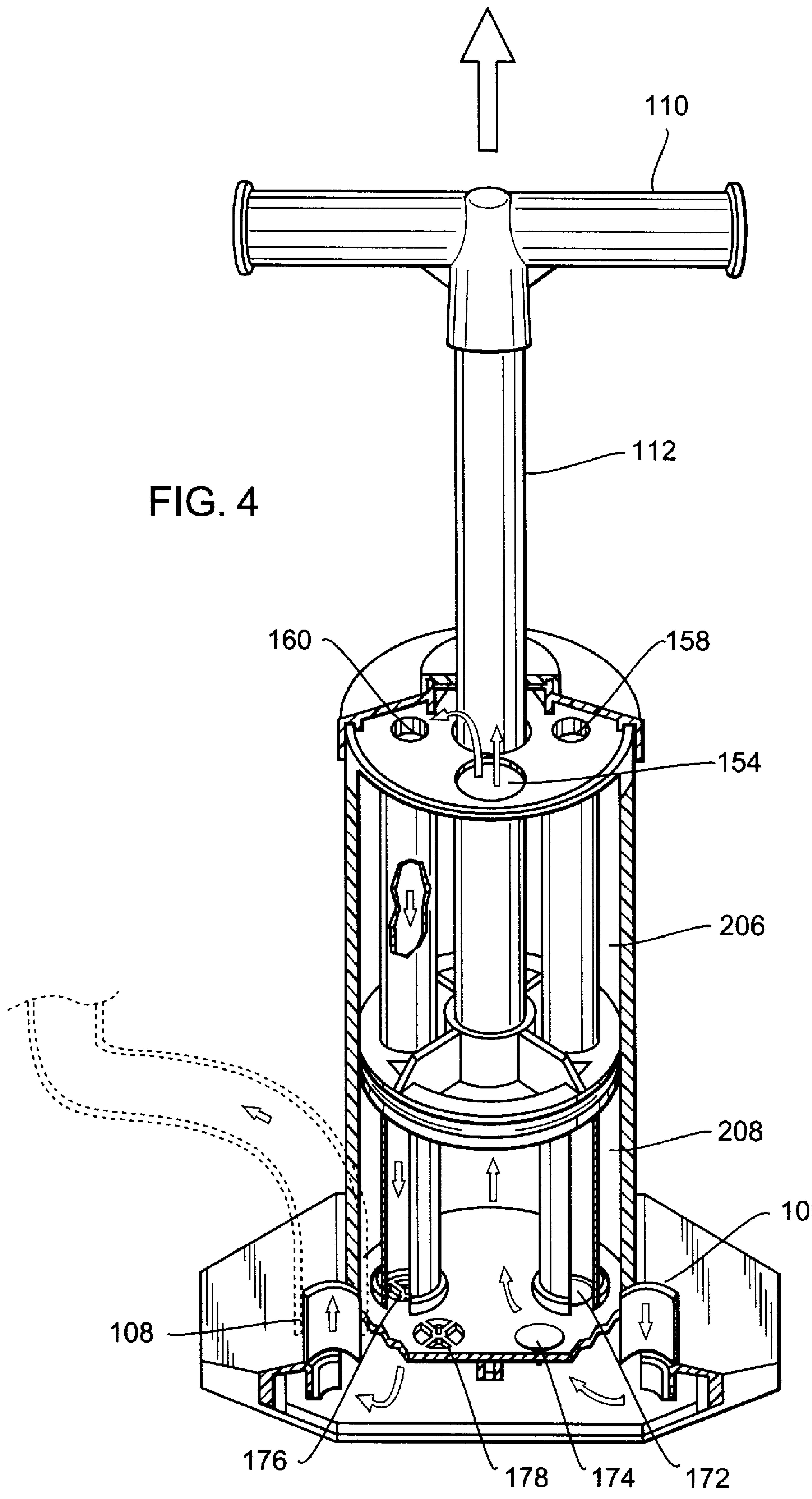
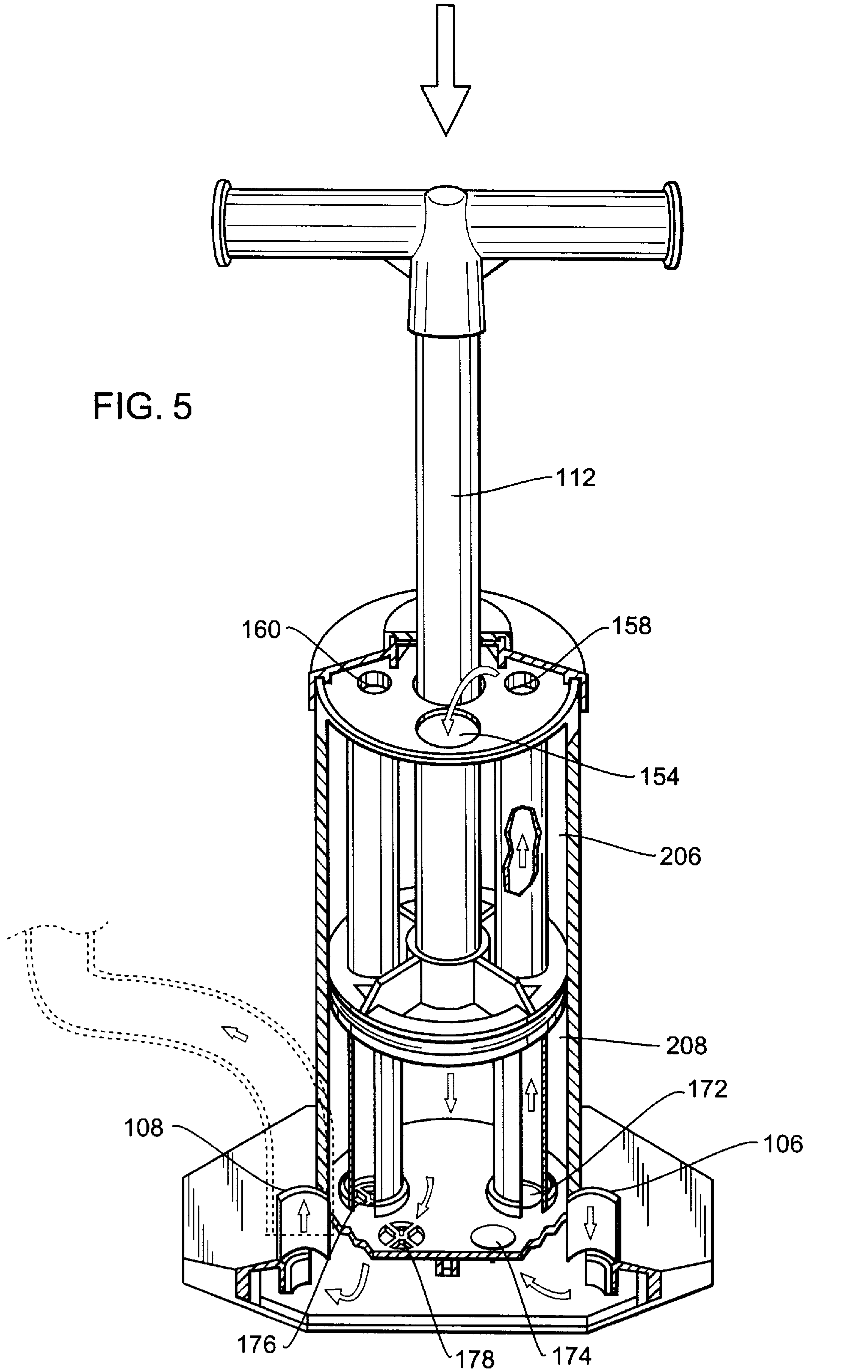


FIG. 5



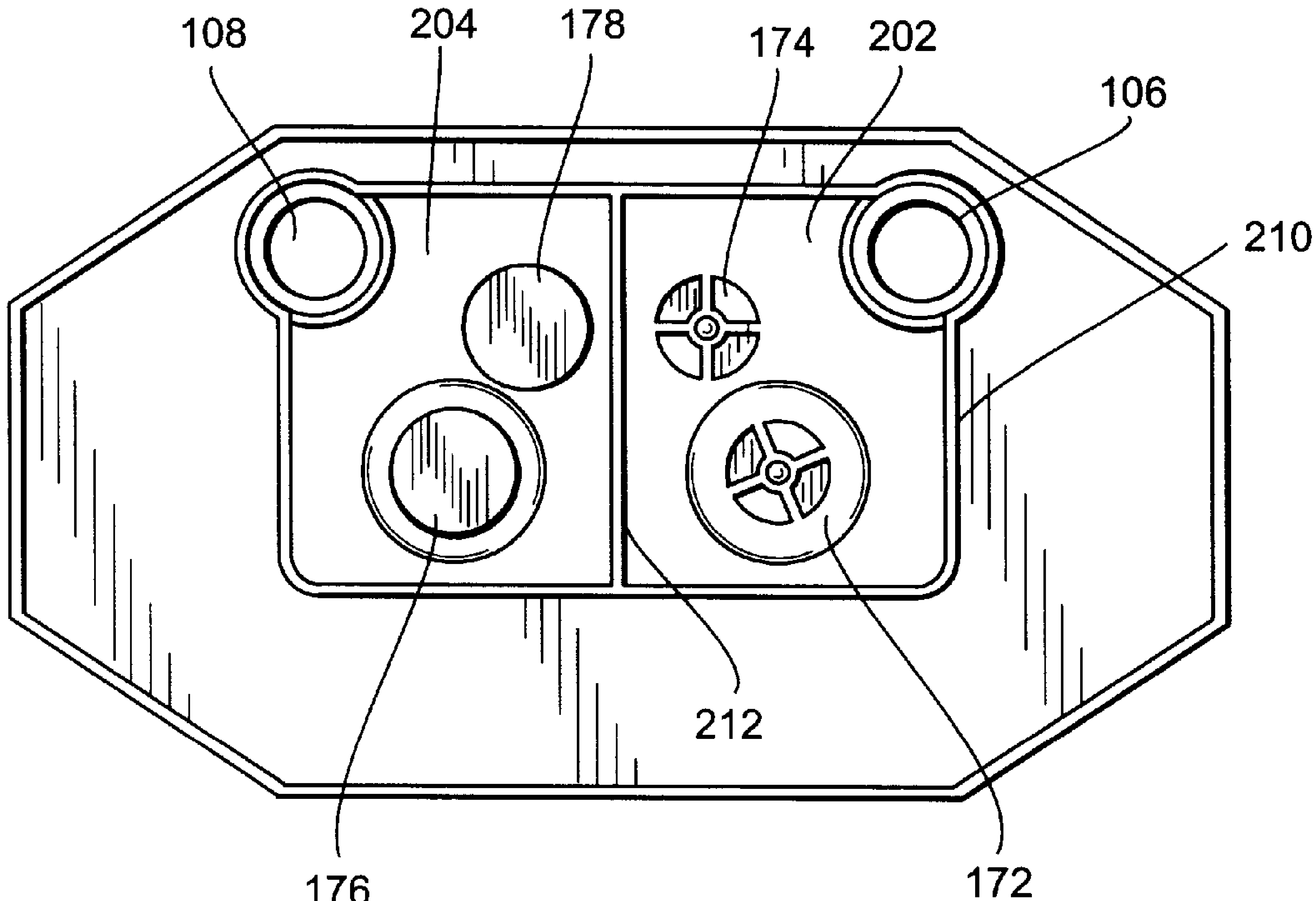


FIG. 6

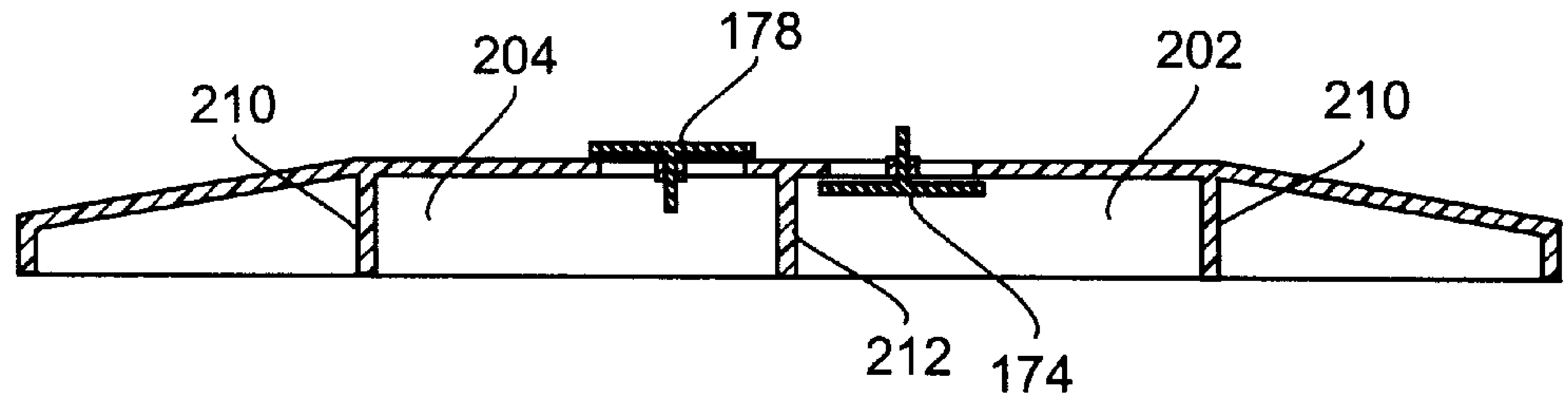


FIG. 7

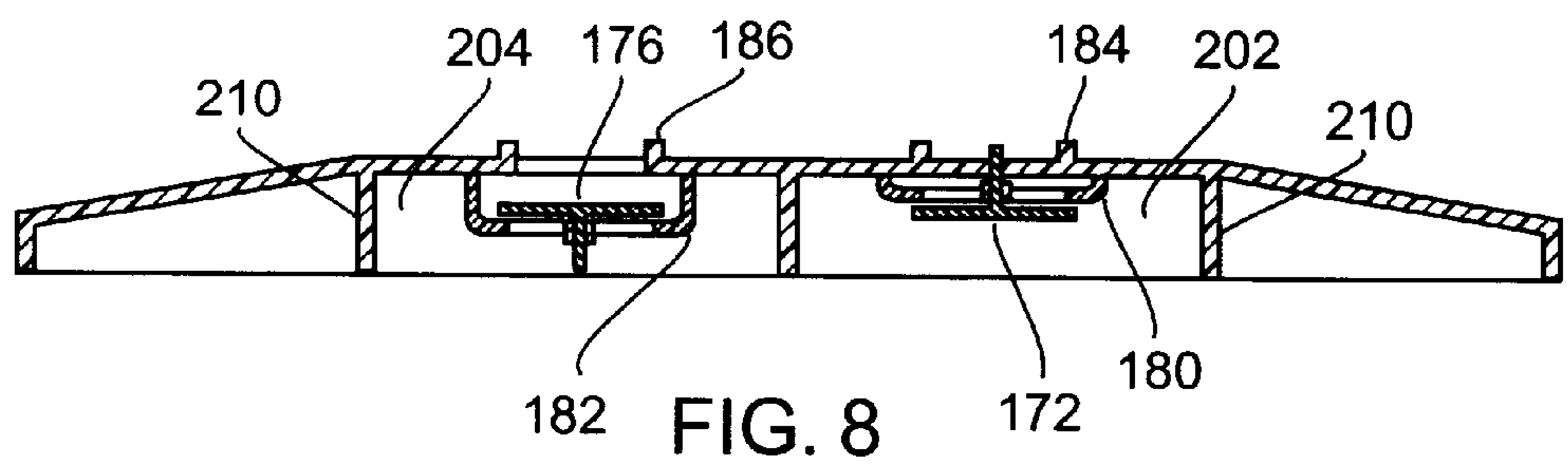


FIG. 8

DUAL ACTION AIR PUMP

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an air pump, and more particularly, to a dual action air pump which can inflate and deflate at the same time and inflate an inflatable object during both up and down stroke to provide continuous discharge of compressed air.

2. Discussion of the Related Art

Children enjoy playing in inflatable toy structures, such as inflatable houses and above-the-ground pools. Conventional inflatable toy structures are inflated by using a manual or foot operated air pumps. The user of a manual air pump, such as a bicycle tire pump or inflatable toy pump, generally encounters difficulties in inflating a pneumatic article, such as a toy structure or tire. When commencing the pumping process, the article has a low (ambient) or no pressure and it is desirable to pump as large a volume of air as possible into the article with each pumping stroke. The user's difficulty at this stage is that many pumping strokes are required unless the volume of air per stroke is large. Conventional single action air pumps discharge the air inside through the air outlet only during the down stroke of the piston shaft. During the upstroke of the piston shaft, outside air is sucked into the air pump through an air inlet but no air is discharged through the air outlet.

Most manual or foot operated air pumps use the check valve concept to control the flow of air into their reservoirs and the subsequent discharging or exhausting of the air from the reservoir into the object being inflated. Check valves are necessarily provided in the air inlet and air outlet in order to control the air flow in a single direction. As an example, foot operated bellows pumps are normally spring loaded and operate with one intake and one exhaust check value. During the compression of the bellows air chamber (or reservoir) air exhausts into the object being inflated and during the spring-back, or up cycle, air refills the reservoir.

Additionally, it is a common manual air pump industry design to have this type of air pump inflate, but not deflate, an object on both the up and down strokes of the pumping cycle. These types of air pumps are commonly referred to as a double or dual action air pumps, and normally have their reservoir cylindrically shaped with intake check valves located at the opposite ends of the cylinder. As the pumping stroke drives the air out of either end of the cylinder, the opposite side check valve opens to allow the opposite side air to be replenished. During the pumping action where air on either side of a piston head is being compressed, the compressed air inflates the intended object by flowing through a side slit in a hollow piston shaft to which a hose is attached that is connected to the object to be inflated.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a dual action air pump that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide an air pump that is used to inflate and deflate an inflatable object by changing a hose to appropriate air port opening.

Another object of the present invention is to provide an air pump that provides a continuous flow of air to an inflatable object during both up and down stroke of the piston shaft.

Another object of the present invention is to provide an air pump that provides a continuous flow of air from an inflatable object during both up and down stroke of the piston shaft.

Another object of the present invention is to provide an air pump that has both intake port and exhaust port that provide a continuous flow of air to and from the inflatable object during both up and down stroke of the piston.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, an air pump comprises a first structure having a hollow interior and a piston slidably disposed in the housing to divide the hollow interior of the housing to first and second reservoirs. In the preferred embodiment, as the piston moves toward a first direction, such as upstroke, the first reservoir is compressed and as the piston moves toward a second direction, such as down stroke, the second reservoir is compressed. The air pump further comprises a second structure having gaseous communication with the first structure. The second structure has intake and exhaust chambers which are not in gaseous communication with each other. The intake chamber is in gaseous communication with an intake port. The exhaust chamber is in gaseous communication with an exhaust port. The air pump also includes first and second intake check valves and first and second exhaust check valves disposed in the air pump. The first intake check valve provides gaseous communication between the second reservoir and the intake chamber when the piston moves in the first direction. The second intake check valve provides gaseous communication between the first reservoir and the intake chamber when the piston moves in the second direction. Similarly, the first exhaust check valve provides gaseous communication between the second reservoir and the exhaust chamber when the piston moves in the second direction, and the second exhaust check valve provides gaseous communication between the first reservoir and the exhaust chamber when the piston moves in the first direction.

According to one aspect of the present invention, the first and second intake check valves are located in the second structure and are dedicated to the intake chamber. The first and second exhaust check valves are also located in the second structure and are dedicated to the exhaust chamber.

In the preferred embodiment, the first structure is a cylindrical housing fixedly attached to the second structure, which is a base, wherein the first and second intake check valves are disposed in the second reservoir of the housing. The first and second intake check valves and the first and second exhaust check valves are preferably co-planarly located on the second structure.

According to another aspect of the present invention, the air pump includes an intake transfer tube connected between the intake chamber and the first chamber with air flow being regulated by the second intake check valve. There is also an exhaust transfer tube connected between the exhaust chamber and the first chamber with air flow being regulated by the second exhaust check valve.

According to another aspect of the invention, a piston shaft is fixedly connected to the piston for biasing the piston between the first and second positions. The piston shaft is parallelly disposed with the intake and the exhaust transfer tubes.

According to another aspect of the present invention, a disk is fixedly attached to one end of the housing. The disk defines an intake conduit connected to the intake transfer tube and further defines an exhaust conduit connected to the exhaust transfer tube. The disk further defines at least one air passage which is in gaseous communication with the first reservoir of the first structure.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide a further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. **1** illustrates a perspective view of a preferred embodiment of the dual action air pump with a piston shaft in a retracted position;

FIG. **2** illustrates a perspective view of the preferred embodiment of the dual action air pump with the shaft piston in an extended position;

FIG. **3** illustrates an exploded view of the dual action air pump;

FIG. **4** illustrates a cross-sectional view of the dual action air pump showing internal components and air flow directions when the piston is moving in a up stroke;

FIG. **5** illustrates a cross-sectional view of the dual action air pump showing internal components and air flow directions when the piston is moving in a down stroke;

FIG. **6** illustrates a bottom planar view of the dual action air pump showing intake and exhaust check valves;

FIG. **7** illustrates a cross-sectional view of intake and exhaust check valves for a lower reservoir; and

FIG. **8** illustrates a cross-sectional view of intake and exhaust check valves for an upper reservoir.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings, and in particular to FIGS. **1–8** thereof, a dual action air pump **100** embodying the principles and concepts of the present invention will be described.

FIG. **1** illustrates a perspective view of a preferred embodiment of the dual action air pump **100** with a piston shaft **112** in a retracted position. FIG. **2** illustrates a perspective view of the preferred embodiment of the air pump **100** with the piston shaft **112** in an extended position. Referring to FIGS. **1** and **2**, the air pump **100** according to the present invention includes a cylindrically shaped hollow reservoir housing **102**, a base **104** connected to one end of the housing **102**, an intake port **106** and an exhaust or inflate port **108** which are located on the base **104**, an elongated piston shaft **112** extending along the longitudinal axis of the housing **102**, and a handle perpendicularly disposed with respect to the piston shaft **112** to assist pumping of the piston shaft **112**. The preferred embodiment of the present invention is directed to a dual action manually driven air pump **100** with a piston and two intake and two exhaust check values that respectively operate with one intake port **106** and one exhaust (or inflation) port **108**. These check valves, which are described below in detail, operate in tandem with each other during each pumping stroke, either up or down. In particular, during each pumping stroke, one intake check valve and one exhaust check valve are open with their counterparts closed, to provide continuous discharge of compressed air through the exhaust port **108** and also to provide continuous intake of air through the intake port **106**.

FIG. **3** illustrates an exploded view of the air pump **100** according to the preferred embodiment of the present invention. As described above, the housing **102** is cylindrically shaped and is divided into upper and lower reservoirs **206** and **208**, as shown in FIG. **4**, by the placement of a piston **130** for concurrently receiving and compressing air. The length and the diameter of the housing **102**, which determines the volume of the reservoirs, may be varied depend on the application of the air pump **100**. The housing **102** is preferably made of rigid plastic, PVC, aluminum or other suitable materials known to one of ordinary skill in the art.

Referring to FIG. **3**, the top opening end of the housing **102** is enclosed with a disk **150** having a plurality of air transport holes. The bottom opening end of the housing **102** is air tightly mounted to the base **104**. Preferably, the top surface of the base **104** has a circular groove **170** for receiving therein the housing **102** in an upright position. The housing **102** and the base **104** may be securely attached to each other using adhesives or other suitable material known to one of ordinary skill in the art.

In the preferred embodiment, the disk **150** is air tightly affixed to the top end of the housing, preferably using adhesives. Alternatively, the disk **150** may have external threads which are fixedly engaged with the matching inner threads of the housing **102**. The disk **150** preferably has a center hole **156** for slidably receiving therein the piston shaft **112**. The diameter of the center hole **156** is about the same as that of the piston shaft **112** to snuggly fit around the circumference of the piston shaft **112**. Aligned with and disposed at opposite ends of the center hole **156** are a plurality of air passages **152** and **154** which are in gaseous communication with the upper reservoir of the housing **102**. In the preferred embodiment, there are two air passages **152** and **154** defined by the disk **150**. Alternative, there may be one or more than two air passages. In addition to the air passages **152** and **154**, there are intake and exhaust conduits **158** and **160** which are in gaseous communication with transfer tubes **162** and **164**. In particular, the intake and exhaust conduits **158** and **160** are linearly aligned with the center hole **156** and are orthogonally positioned with respect to the air passages **152** and **154**.

Referring further to FIG. **3**, the top end of the housing **102** has outer threads for receiving thereon a cover **120** which has matching inner threads. Once placed on the housing **102**, the cover **120** forms an air tight seal. The cover **120** has a piston shaft hole **124** which shares the same center axis as the cover **120**. The piston shaft hole **124** is surrounded by a rim **122** having an O-ring therein to provide substantially an air tight seal with the piston shaft **112**. The cover **120** also includes an input port **126** having a check valve biased to open only during a down stroke of the piston shaft **112** to fill the upper reservoir **206**.

Referring to FIG. **3**, parallelly extending from the bottom surface of the disk **150** are intake transfer tube **162** and exhaust transfer tube **164**. Preferably, the intake transfer tube **162**, the exhaust transfer tube **164** and the piston shaft **112** are in co-planarly position with respect to each other. The intake and exhaust transfer tubes **162** and **164** are elongated cylinders of identical shape and form having a hollow interior for transferring air between chambers located in the base **104**. The intake and exhaust transfer tubes **162** and **164** extend along the length of the housing **102** and are in gaseous communication with the upper reservoir **206**, but are not in gaseous communication with the lower reservoir **208** of the housing **102**. The intake transfer tube **162** is fixedly connected and is dedicated to an intake transfer tube valve **172**. The exhaust transfer tube **164** is fixedly connected and is dedicated to an exhaust transfer tube valve **176**. As a result, the intake and exhaust transfer tubes **162** and **164** act as air conduits feeding and exhausting air to and from the upper reservoir **206**.

According to FIG. **3**, the air pump **100** also includes an elongated piston shaft **112** which is connected to the handle **110** at one end and is connected to a piston **130** at the opposite end. The piston shaft **112** and the handle **110** form a T-shaped structure. The piston **130** has a generally circular construction and has a center hole for mounting therein the end of the piston shaft **112**. There are also two transfer tube through-holes **132** and **134** for slidably receiving therethrough the intake and the exhaust transfer tubes **164** and **162**, respectively. The through holes **132** and **134** are each configured to be slightly larger in diameter than that of the transfer tubes **164** and **162** and provide air tight seals around the transfer tubes **164** and **162** to separate the upper and lower reservoirs **206** and **208**. The through holes **132** and **134** are aligned with the intake and the exhaust conduits **158** and **160** so that the air transfer tubes **162** and **164** run co-planar and parallel to the piston shaft **112**.

Around the circumference of the piston **130**, there is provided a groove rail for receiving therein an O-ring **136**. The O-ring **136** in piston **130** rubs against the inner wall of the upper and the lower reservoirs **206** and **208**. The O-ring **136** provides an air tight seal between the piston **130** and the inner wall of the housing **102** to compress air in the upper reservoir **206** when the piston **130** is moved upward and in the lower reservoir **208** when the piston **130** is moved downward.

According to FIG. **3**, the air pump **100** also includes the base **104** which is perpendicularly connected to the housing **102** for forming an air tight seal at the contact joint. A perspective view of the base **104** is shown in FIG. **3**, and a bottom plan view of the base **104** is shown in FIG. **6**. Referring to FIG. **3**, the base **104** includes intake valve **174** and exhaust valve **178** which are both dedicated to the lower reservoir **208**, and intake transfer tube valve **172** and exhaust transfer tube valve **176** which are both dedicated to the upper reservoir **206**. All four check valves, namely intake transfer tube valve **172**, intake valve **174**, exhaust transfer tube valve **176** and exhaust valve **178**, are located within the boundary defined by the lower opening of the housing **102**. In particular, the intake and the exhaust transfer tube valves **172** and **176** are located immediately below the corresponding intake and exhaust transfer tubes **162** and **164**, respectively. In other words, the intake transfer tube valve **172** is in gaseous communication with the intake transfer tube **162**. Similarly, the exhaust transfer tube valve **177** is in gaseous communication with the exhaust transfer tube **164**. In the preferred embodiment, all four check valves **172, 174, 176** and **178** are co-planarly located on the top of the base **104**.

The construction of check valves is well known in the art. For example, each check valve used in the present invention includes a circular flexible disk, preferably made of rubber, having a center projection for engaging a valve opening. The valve is biased in one direction to permit unidirectional air flow.

Referring to FIG. **3**, the base **104** also includes an intake port **106** and an exhaust port **108**, which are in gaseous communication with an intake chamber **202** and an exhaust chamber **204**, respectively. The intake chamber **202** includes the two intake check valves **172** and **174** and has a single intake port **106**. The exhaust chamber **204** includes the two exhaust check valves **176** and **178** and has a single exhaust port **108**. In the preferred embodiment, the intake transfer tube valve **172** and the intake valve **174** are positioned on one side of the base **104** to share the intake chamber **202** shown in FIG. **6**. The exhaust transfer tube valve **176** and the exhaust valve **178** are positioned on the opposite side of the base **104** to share the exhaust chamber **204**.

The intake port **106** is used for receiving or deflating air from outside. When connected to an inflatable article, the intake port **106** will continuously intake air to deflate such article. The exhaust port **108** is used for inflating by force outputting the compressed air inside the housing **102**. The intake port **106** is in gaseous communication with the intake chamber **202**. The exhaust port **108** is in gaseous communication with the exhaust chamber **204**.

Referring to FIG. **3**, there is provided a chamber cover **220** having a raised wall **222** in the shape of the chamber wall **210** and the dividing wall **212**. The raised wall **222** is two layered with a rubber sealing ring **224** in between. The chamber cover **220** is preferably attached to the bottom of the base **104** around the intake and the exhaust chambers **202** and **204** using fasteners such as screws, or other suitable method. When the chamber cover **220** is placed against the chambers **202** and **204**, the sealing ring **224** abuts against the top of the chamber wall **210** and the dividing wall **212** so that the chamber cover **220** maintains an air tight seal of the chambers **202** and **204**. Once the chamber cover **220** is placed, the bottom of the base **104** is enclosed with a similarly shaped base cover **230**.

FIG. **6** illustrates a bottom planar view of the air pump **100**, and particularly the base **104**, showing intake and exhaust check valve arrangement. FIG. **7** illustrates a cross-sectional view of intake and exhaust valves for a lower reservoir **208**. FIG. **8** illustrates a cross-sectional view of intake and exhaust valves for an upper reservoir **206**. Referring to FIG. **6**, the intake and the exhaust chambers **202** and **204** are defined by a generally rectangular chamber wall **210**. The intake and the exhaust chambers **202** and **204** are divided by a dividing wall **212** which is of substantially the same height as the wall **210**.

Referring to FIGS. **6** and **7**, there are shown the exhaust valve **178** which is in gaseous communication with the exhaust chamber **204**, and the intake valve **174** which is in gaseous communication with the intake chamber **202**. Referring to FIGS. **6** and **8**, there are shown the exhaust transfer tube valve **176** which is in gaseous communication with the exhaust chamber **204**, and the intake transfer tube valve **172** which is in gaseous communication with the intake chamber **202**. According to the preferred embodiment of the present invention, the intake transfer tube valve **172** is installed on an intake platform **180** and the exhaust transfer tube valve **182** is installed on an exhaust platform **182**. On the top surface of the base **104** surrounding the intake and the exhaust transfer tube valves **172** and **176**, there are circular rims **184** and **186** for receiving therein the intake and the exhaust transfer tubes **162** and **164**, respectively. The circular rims **184** and **186** have a diameter which is slightly larger than that of the tubes **162, 164** and are respectively attached to each other using adhesives to provide an air tight seal from the lower reservoir **208**.

The operation of the air pump **100** according to the preferred embodiment of the present invention will now be described in reference to FIGS. **4** and **5**. FIG. **4** illustrates a cross-sectional view of the air pump **100** showing internal components and air flow directions when the piston is moving upward. As the piston **130** travels up and down, the upper and the lower reservoirs **206** and **208** compress or expand as shown in FIGS. **4** and **5**, respectively. The intake port **106** and the exhaust port **108** are always unrestricted and open and feed or exhaust the intake chamber **202** and the exhaust chamber **204**.

In an upstroke, the air in the upper reservoir **206** is compressed and is exhausted through the exhaust port **108** as the lower reservoir **208** is filled up with air received from the intake port **106**. In particular, the intake valve **174** opens and feeds lower reservoir **208** of the housing **102**. Concurrently, the exhaust valve **178** is kept closed from back pressure in the exhaust chamber **204**, while the lower reservoir **208** is filled with air received from the intake port **106** of the intake chamber **202** through the intake valve **174**. The compressed air in the upper reservoir **206** exits through the air passage **154**, enters the exhaust conduit **160**, moves down the exhaust transfer tube **164** into the exhaust chamber **204**, and exits through the exhaust port **108**. The following is the status of various valves used in the air pump **100** during the upstroke.

UPSTROKE SUMMARY

Intake valve 174	Opens to feed lower reservoir 208
Intake transfer tube valve 172	Closes
Exhaust valve 178	Closes
Exhaust transfer tube valve 176	Opens to feed exhaust chamber 204

FIG. **5** illustrates a cross-sectional view of the air pump **100** showing internal components and air flow directions when the piston **130** is in a down stroke. In a down stroke, the lower reservoir **208** is compressed and the air therein exhausts through the exhaust port **108** while the upper reservoir **206** is filled up with air received from the intake port **106**. During a down stroke, the intake valve **174** closes and the exhaust valve **178** opens allowing the compressed air in the lower reservoir **208** to escape or exhaust into the exhaust chamber **204**. The compressed air then exits through the exhaust port **108**. The intake transfer tube valve **172** for the upper reservoir **206** opens with air travelling through the intake port **106** into the intake chamber **202**, through the intake transfer tube valve **172**, and up the intake transfer tube **162**. The air then exits through the intake conduit **158** and travels into the upper reservoir **206** through the air passage **154**. During a down stroke, the exhaust transfer tube valve **176** is kept closed from the back pressure in the exhaust chamber **204**. The following is the status of various valves used in the air pump **100** during the down stroke.

DOWN STROKE SUMMARY

Intake valve 174	Closes
Intake transfer tube valve 172	Opens to feed upper reservoir 206
Exhaust valve 178	Opens to feed exhaust chamber 204
Exhaust transfer tube valve 176	Closes

As described above, on the reversing of the stroke, the check valves that were previously open now become closed and those that were closed now become open. This results in a continuous flow of air, to or from the inflatable object, depending upon whether the air hose is connected to the intake or to the exhaust port.

Although the air pump **100** described above is directed to a manually operated pump, the gist of the present invention may also be applied to an electric-type pump using the same check valve configuration.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. An air pump comprising:

a first structure having a hollow interior;

a piston slidably disposed in the housing to divide the hollow interior of the housing to first and second reservoirs, wherein as the piston moves toward a first direction, the first reservoir is compressed and as the piston moves toward a second direction, the second reservoir is compressed;

a second structure having gaseous communication with the first structure, the second structure having intake and exhaust chambers which are not in gaseous communication with each other, the intake chamber being in gaseous communication with an intake port, the exhaust chamber being in gaseous communication with an exhaust port; and

first and second intake check valves disposed in the air pump, wherein the first intake check valve provides gaseous communication between the second reservoir and the intake chamber when the piston moves in the first direction, and the second intake check valve provides gaseous communication between the first reservoir and the intake chamber when the piston moves in the second direction.

2. The air pump of claim **1**, further comprising:

first and second exhaust check valves disposed in the air pump, wherein the first exhaust check valve provides gaseous communication between the second reservoir and the exhaust chamber when the piston moves in the second direction, and the second exhaust check valve provides gaseous communication between the first reservoir and the exhaust chamber when the piston moves in the first direction.

3. The air pump of claim **2**, wherein the first and second exhaust check valves are located in the second structure and are dedicated to the exhaust chamber.

4. The air pump of claim **2**, wherein the first structure is a cylindrical housing fixedly attached to the second structure, wherein the first and second exhaust check valves are disposed in the second reservoir of the housing.

5. The air pump of claim **2**, further comprising an exhaust transfer tube connected between the exhaust chamber and the first chamber with air flow being regulated by the second exhaust check valve.

6. The air pump of claim **2**, further comprising a piston shaft fixedly connected to the piston for positioning the piston between the first and second positions.

7. The air pump of claim **2**, wherein the first and second intake check valves and the first and second exhaust check valves are co-planarly located on the second structure.

8. The air pump of claim **1**, wherein the first and second intake check valves are located in the second structure and are dedicated to the intake chamber.

9. The air pump of claim **1**, wherein the first structure is a cylindrical housing fixedly attached to the second structure, wherein the first and second intake check valves are disposed in the second reservoir of the housing.

10. The air pump of claim **1**, further comprising an intake transfer tube connected between the intake chamber and the first chamber with air flow being regulated by the second intake check valve.

11. The air pump of claim **10**, further comprising an exhaust transfer tube connected between the exhaust chamber and the first chamber with air flow being regulated by the second exhaust check valve.

12. The air pump of claim **11**, further comprising a piston shaft fixedly connected to the piston for positioning the piston between the first and second positions, wherein the piston shaft is parallelly disposed with the intake and the exhaust transfer tubes.

13. The air pump of claim **11**, firer comprising a disk fixedly attached to one end of the housing, wherein the disk defines an intake conduit connected to the intake transfer tube and further defines an exhaust conduit connected to the exhaust transfer tube.

14. The air pump of claim **13**, wherein the disk further defines at least one air passage which is in gaseous communication with the first reservoir of the first structure.

15. The air pump of claim **1**, further comprising a piston shaft fixedly connected to the piston for positioning the piston between the first and second positions.

16. An air pump comprising:

a housing having a hollow interior and first and second ends, the second end of the housing being closed with a cover defining a through hole;

a piston shaft slidably disposed through the through hole of the cover, the piston shaft having an end with a piston slidably disposed in the housing to divide the hollow interior of the housing to first and second reservoirs, wherein as the piston moves toward a first direction, the first reservoir is compressed and as the piston moves toward a second direction, the second reservoir is compressed;

a seal disposed around the piston, the seal having an outer periphery contacting an inner periphery of the housing;

a base having gaseous communication with the housing and fixedly connected to the first end of the housing, the base having intake and exhaust chambers which are not in gaseous communication with each other, the intake chamber being in gaseous communication with an intake port, the exhaust chamber being in gaseous communication with an exhaust port;

first and second intake check valves disposed in the air pump, wherein the first intake check valve provides gaseous communication between the second reservoir and the intake chamber when the piston moves in the first direction, and the second intake check valve provides gaseous communication between the first reservoir and the intake chamber when the piston moves in the second direction;

first and second exhaust check valves disposed in the air pump, wherein the first exhaust check valve provides gaseous communication between the second reservoir and the exhaust chamber when the piston moves in the second direction, and the second exhaust check valve provides gaseous communication between the first reservoir and the exhaust chamber when the piston moves in the first direction;

an intake transfer tube connected between the intake chamber and the first chamber with air flow being regulated by the second intake check valve; and

an exhaust transfer tube connected between the exhaust chamber and the first chamber with air flow being regulated by the second exhaust check valve.

17. The air pump of claim **16**, wherein the first and second intake check valves are located in the second structure and are dedicated to the intake chamber.

18. The air pump of claim **17**, wherein the first and second exhaust check valves are located in the second structure and are dedicated to the exhaust chamber.

19. The air pump of claim **18**, wherein the housing is fixedly attached to the second structure, wherein the first and second exhaust check valves are disposed in the second reservoir of the housing.

20. The air pump of claim **16**, wherein the housing is fixedly attached to the second structure, wherein the first and second intake check valves are disposed in the second reservoir of the housing.

21. The air pump of claim **16**, wherein the first and second intake check valves and the first and second exhaust check valves are co-planarly located on the base.

22. The air pump of claim **16**, further comprising a disk fixedly attached to the second end of the housing, wherein the disk defines an intake conduit connected to the intake transfer tube and defines an exhaust conduit connected to the exhaust transfer tube.

23. The air pump of claim **22**, wherein the disk further defines at least one air passage which is in gaseous communication with the first reservoir of the housing.

24. An air pump comprising:

a cylindrical housing having a hollow interior;

a piston slidably disposed in the housing to divide the hollow interior of the housing to first and second reservoirs, wherein as the piston moves toward a first direction, the first reservoir is compressed and as the piston moves toward a second direction, the second reservoir is compressed;

a second structure having gaseous communication with the first structure, the second structure having intake and exhaust chambers which are not in gaseous communication with each other, the intake chamber being in gaseous communication with an intake port, the exhaust chamber being in gaseous communication with an exhaust port;

first and second intake valve means, wherein the first intake check valve means is provided for controlling air flow between the second reservoir and the intake chamber when the piston moves in the first direction, and the second intake check valve means is provided for controlling air flow between the first reservoir and the intake chamber when the piston moves in the second direction; and

first and second exhaust check valve means, wherein the first exhaust check valve means is provided for controlling air flow between the second reservoir and the exhaust chamber when the piston moves in the second direction, and the second exhaust check valve means is provided for controlling air flow between the first reservoir and the exhaust chamber when the piston moves in the first direction.

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